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Dedication

UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 CFR 1.53(b))

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Inventor(s) : Ted F. RABENKO, Ian CRAYFORD, and David L. HARTMAN, Jr.
Title : NETWORK TELEPHONY SYSTEM
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1. X **FEE TRANSMITTAL FORM** (Submit an original, and a duplicate for fee processing).

2. IF A CONTINUING APPLICATION

_____ This application is a _____ of patent application No. _____.

X This application claims priority pursuant to 35 U.S.C. §119(e) and 37 CFR §1.78(a)(4), to provisional Application No. 60/110,211, filed November 30, 1998 (CPH Docket No. 33796).

3. APPLICATION COMPRISED OF

Specification

47
Specification, claims and Abstract (total pages)

Drawings

7 Sheets of drawing(s) (FIGS. 1 to 7)

Declaration and Power of Attorney

____ Newly executed

X No executed declaration

Copy from a prior application (37 CFR 1.63(d))(for continuation and divisional)

4. _____ Microfiche Computer Program (*Appendix*)

5. **Nucleotide and/or Amino Acid Sequence Submission** *(if applicable, all necessary)*

Computer Readable Copy

_____ Paper Copy (identical to computer copy)

Statement verifying identity of above copies

6. ALSO ENCLOSED ARE

Preliminary Amendment

— A Petition for Extension of Time for the parent application and the required fee are enclosed as separate papers

Small Entity Statement(s)

____ Statement filed in parent application, status still proper and desired

Copy of Statement filed in provisional application, status still proper and desired

UTILITY PATENT APPLICATION TRANSMITTAL
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Docket No.: 36158/NEC/B600

- ☐ An Assignment of the invention with the Recordation Cover Sheet and the recordation fee are enclosed as separate papers
- ☐ This application is owned by pursuant to an Assignment recorded at Reel , Frame
- ☐ Information Disclosure Statement (IDS)/PTO-1449
- ☐ Copies of IDS Citations
- ☐ Certified copy of Priority Document(s) (*if foreign priority is claimed*)
- ☐ English Translation Document (*if applicable*)
- ☒ Return Receipt Postcard (MPEP 503) (should be specifically itemized).
- ☐ Other

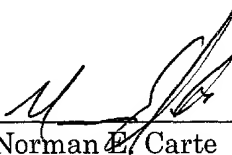
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NEC/llb

NETWORK TELEPHONY SYSTEM

5 RELATED APPLICATION

This patent application claims the benefit of the filing date of United States Provisional Patent Application Serial No. 60/110,211, filed November 30, 1998 and entitled 3 PORT ETHERNET SWITCH AND MICROPROCESSOR FOR VOICE COMMUNICATION, the entire
10 contents of which are hereby expressly incorporated by reference.

FIELD OF THE INVENTION

The present invention relates generally to computer network systems. The present invention relates more particularly to a
15 system for facilitating telephony over a computer network, such as an Ethernet network.

BACKGROUND OF THE INVENTION

Ethernet networks and the like for providing data communication among a plurality of computers are well-known. Such networks facilitate the transfer of data files, audio information and video information, as well as any other information which may be represented in binary form, among the plurality of computers.

Typically, one or more of the computers is configured as a server and generally defines a repository for frequently used files. The other, e.g., non-server, computers are generally referred to as clients and may frequently receive files from the server. Client computers may also communicate information to one
30 another.

Although common, servers are not a necessary part of all networks. In peer-to-peer networks, client or non-server computers communicate among one another to facilitate file transfer.

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5 Networks can be conveniently divided into two broad categories, based upon their size. A local area network (LAN) is a group of computers which are connected so as to facilitate the sharing of applications, data and peripherals. Local area networks are generally confined to a single building or a small group of buildings.

10 A wide area network (WAN) is made up of a plurality of LANs which are connected together so as to facilitate communication therebetween. A WAN may cover a city, a state, a country or even be international in scope. The Internet is an example of a WAN that includes more than 2,000 separate packet-switched networks that are located all over the world.

15 Networks, particularly WANs, are typically interconnected by a variety of network devices such as hubs, switches, routers and/or bridges.

20 A hub is a multiport repeater that facilitates the interconnection of a plurality of computers (one for each port of the hub).

25 A switch is a network device which is capable of reading and modifying header information associated with data packets, including header information which specifies the priority with which the data packets are to be queued within a buffer of a network device (including the switch itself).

A router is a network device that interconnects a plurality of separate LANs or WANs, wherein each of the networks utilizes the same network protocol and operates at the network layer, or Layer 3, of the ISO model.

30 A bridge is a network device that interconnects a plurality of separate LANs or WANs, wherein at least two of the networks utilize a different network protocol with respect to one another and operates at the Data Link/MAC layer, or Layer 2 of the ISO model.

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The popularity of the Internet has increased the desire for additional network services such as network telephony. The vast, high bandwidth network which defines the Internet provides an ideal medium for audio communications.

Thus, it is desirable to provide a system for facilitating audio communication over networks such as the Internet.

10 SUMMARY OF THE INVENTION

The present invention includes a network telephone having a microphone coupled to facilitate provision of voice data to a network, a speaker coupled to facilitate listening to voice data from the network, a dialing device coupled to facilitate routing of voice data upon the network, a first port configured to facilitate communication with a first network device, a second port configured to facilitate communication with a second network device and a prioritization circuit coupled to apply prioritization to voice data provided by the microphone.

20 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a drawing showing the network telephone of the present invention electrically installed between a first network device, e.g., a personal computer and a second network device, e.g., a network switch;

FIG. 2 is a block diagram showing the network telephone generally;

FIG. 3 is a block diagram showing the Internet Protocol switch controller of the present invention;

FIG. 4 is a block diagram showing the voice engine processor of the present invention;

FIG. 5 is a flowchart showing processing for an incoming voice packet;

FIG. 6 is a flowchart showing processing for an outgoing voice data packet; and

FIG. 7 is a flowchart showing differences in processing for
low priority (non-voice data) and high priority (voice data)
5 packets.

DETAILED DESCRIPTION OF THE INVENTION

The detailed description set forth below in connection with
the appended drawings is intended as a description of the
10 presently preferred embodiment of the invention and is not
intended to represent the only form in which the present
invention may be constructed or utilized. The description sets
forth the functions and the sequence of steps for constructing
and operating the invention in connection with the illustrated
15 embodiment. It is to be understood, however, that the same or
equivalent functions and sequences may be accomplished by
different embodiments that are also intended to be encompassed
within the spirit and scope of the invention.

Although the present invention is described below and
20 illustrated in the drawings as being configured for use in an
Ethernet network, those skilled in the art will appreciate that
the network telephone of the present invention is likewise
suitable for use in various other network environments. Thus,
description and illustration of the network telephone in an
25 Ethernet network is by way of example only and not by way of
limitation.

The present invention includes a network telephone having
a microphone coupled to facilitate provision of voice data to a
network, a speaker coupled to facilitate listening to voice data
30 from the network, a dialing device coupled to facilitate routing
of voice data upon the network, a first port configured to
facilitate communication with a first network device, a second
port configured to facilitate communication with a second network
device and a prioritization circuit coupled to apply
35 prioritization to voice data provided by the microphone and

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detect prioritization of traffic received from either one or both of the network ports. The prioritization circuit is optionally
 5 coupled to apply prioritization to voice data communicated to the network telephone via the first and/or second ports.

The first port is configured to facilitate communication of voice packets and non-voice packets with the first network device such as a personal computer, and the second port is similarly
 10 configured to facilitate communication of voice packets and non-voice packets with the second network device such as a network switch. The first and second ports optionally comprise Ethernet 10/100 ports.

The microphone and the speaker are optionally part of a
 15 handset. The dialing device may be defined by a keypad. However, those skilled in the art will appreciate that various other types of dialing devices, e.g., touchpads, voice control, etc., are likewise suitable.

According to one aspect of the present invention, the
 20 prioritization circuit is configured to tag voice packets, so as to facilitate prioritization thereof. The prioritization circuit is also configured to read tags associated with data packets provided to the network telephone by the network. Thus, data packets being transmitted from the network telephone to the
 25 network are processed by the network according to the priority assigned by the prioritization circuit and data packets received by the network telephone are similarly processed according to their assigned priority, as discussed in detail below.

According to one aspect of the present invention, the
 30 prioritization is defined by a network switch, such as an Ethernet switch. As those skilled in the art will appreciate, a network switch may be configured to add tags to data packets which pass therethrough, so as to associate a priority with the data packets. The priority determines the order of processing
 35 by various network devices. The integral network switch of the

network telephone of the present invention functions as a network switch controller, since the integral network switch of the network telephone uses such tags to effect control of network switches throughout the network.

A voice engine processor in communication with the network switch is configured to digitize and compress voice data from the microphone and to decompress and perform digital-to-analog conversion upon voice data provided to the speaker. The voice engine processor is also configured to depacketize voice data which is being provided to the speaker (typically from the network) and to packetize voice data which is provided by the microphone.

Thus, according to the present invention, the Internet Protocol switch controller functions as a network switch, so as to facilitate the prioritization of voice data packets. As those skilled in the art will appreciate, the prioritization of voice data packets tends to assure that the voice data packets are not undesirably delayed as they are routed across a network, such as the Internet, from the source network telephone to another network telephone or the like.

Of course, such delays are undesirable because they cause the speech to be interrupted or broken, and may, indeed, result in lost voice packets which cause the speech to be garbled or otherwise unintelligible.

By adding prioritization to voice data which originates at the network telephone of the present invention, the voice data packets tends to be queued ahead of other, lower priority, data packets at various network devices which perform buffering, such as switches, routers, bridges, hubs and the like. The addition of priority to voice data packets assures prompt processing of the voice data packets by network devices.

The network telephone of the present invention is suitable for use in various different types of networks, including but not

limited to LANs, WANs, intranets and internets, as well as the Internet.

Referring now to FIG. 1, a network telephone system 100 includes a network telephone 101 electrically connected between a first network device such as a personal computer 102 and a second network device, such as a hub, router, bridge, other network computer or switch 103. The network telephone 101 is electrically connected to the personal computer 102 via cable 104 which attaches to a first input/output port 313 of the network telephone 101. Similarly, the Internet telephone 101 is connected to the network switch 103 via cable 105 which attaches to input/output port 314 of the network telephone 101.

Thus, according to the present invention, installation of a network telephone 101 simply involves disconnecting an existing cable between a personal computer 102 and a network device such as a network switch 103, and connecting the network telephone 100 between the personal computer 102 and the network switch 103. Thus, the network telephone 101 is merely inserted in series between the personal computer 102 and the network switch 103 such that the network telephone may then intercept voice data packets from the network and may insert voice data packets onto the network.

Not only must the Internet telephone 101 facilitate transmission and reception of voice data packets to and from the network but the network telephone 101 must also allow data packets from the network to be transmitted to the personal computer 102 and allow data packets transmitted from the personal computer 102 to be forwarded to the network.

However, as those skilled in the art will appreciate, the personal computer 102 is not required for the network telephone 101 to function. Thus, the network telephone 101 may alternatively be electrically connected only to the network switch 103 or some other network device. Indeed, those skilled

in the art will appreciate that the network telephone 101 may be connected in a variety of different manners to the network, including but not limited to a radio connection, an infrared connection, a fiber optic connection or any other desired type of connection.

Although FIG. 1 depicts a conventional telephone, having a keypad 204 and a handset 106, those skilled in the art will appreciate that various other telephony devices are likewise suitable. For example, the network telephone 101 may comprise a headset and may alternatively utilize voice recognition for dialing. Indeed, the network telephone 101 may define any desired configuration of voice telephone.

Referring now to FIG. 2, the network telephone 101 comprises an Internet Protocol switch controller 201 and a voice engine processor 202 which cooperate to facilitate telephonic communication via a network, such as the Internet. The Internet Protocol switch 201 and the voice engine processor 202 are each formed as separate, single chips. However, future integration may allow these as well as other functions to be implemented in a single chip. The Internet Protocol switch controller 201 facilitates the application of enhanced priority to voice packets in order to assure that the voice packets are not undesirably delayed during transmission to a recipient via the network, as described in detail below. The voice engine processor 202 performs analog-to-digital conversion upon voice from microphone 211, compresses the digitized voice and packetizes the digitized voice for transmission upon the network. The voice engine processor 211 also depacketizes, decompresses and performs digital-to-analog conversion upon voice information from the network such that the voice information may be listened via speaker 212, as also described in detail below

The Internet Protocol switch controller 201 substantially comprises a network switch which is capable of adding tags to

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network data packets, as well as reading existing tags of network packets. Priority is applied to the network packets via the use
5 of such tags and existing priority information is read from network packets having such tags.

The Internet Protocol switch controller 201 may be configured to accommodate maximum frame sizes of both 1522 and 1548 bytes.

10 1522 bytes maximum frame length supports the IEEE 802.3ac VLAN tag specification while 1548 bytes allow alternate tagging schemes, with up to 30 bytes of tag field (i.e., user's ISL). Generally, packetized voice will consist of minimax data frames generally of 64 bytes, or 68 bytes with the 802.3ac tag.

15 The Internet Protocol switch controller 201 interfaces with the voice engine processor 202 via a data interface, such as media independent interface 203 and with a control interface, such as microprocessor interface 204. Those skilled in the art will appreciate that various other types of interfaces for
20 facilitating communication between the Internet Protocol switch controller 201 and the voice engine processor 202 are likewise suitable.

Magnetics 207 and 208 provide DC isolation and impedance matching at media dependent interfaces 313 and 314, respectively.
25 Media dependent interface 313 facilitates connection to the personal computer 102 (FIG. 1) or the like via network interface adapter (NIC) connection 205 and media dependent interface 314 similarly provides communication to a network, e.g., network switch 103 via switch connector 206.

30 The voice engine processor 202 is in communication with keypad 209, which is used to facilitate desired routing of the voice packets from the network telephone 101, through the network, to a desired recipient. It is worthwhile to note that the desired recipient may be a similar Internet telephone, a
35 computer such as a personal computer 102, a server which archives

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the voice packets for later use, or a conventional telephone accessed via the public switched telephone network. The voice data provided by the network telephone 101 may leave the network and be transmitted via the public switch telephone system.

Indeed, a voice message provided by the network telephone 101 may, if desired, be converted into a text message via voice recognition software. The text message may then be routed to a computer, such as via e-mail, may be routed to a fax machine, may be routed to an alpha/numeric pager or may be routed to any other desired text device.

The Internet connection between the network telephone 101 and the personal computer 102 preferably includes an Ethernet 10/100 connection. Similarly, the connection between the Internet telephone 101 and the network switch 103 preferably includes an Ethernet 10/100 connection.

The keypad 209 may be a contemporary keypad such as those used upon standard telephones. However, the keypad 209 may alternatively be any desired input device, such as a computer keyboard, a voice recognition system, a rotary dial, or any other desired input device.

The LCD display 210 is utilized to display the dialed number, as well as any other desired information such as network status, caller identification, etc.

Referring now to FIG. 3, the Internet Protocol switch controller 201 is shown in further detail. The Internet Protocol switch controller 201 comprises a bus 316 for facilitating communication among various portions thereof. The Internet Protocol switch controller 201 generally defines a network switch and has a switch engine queuing manager 301, a VLAN 802.1Q address look-up engine 302, an address resolution logic/virtual local area network (ARL/VLAN) table 303, an LED interface 304, a first 10/100 MAC 305, a second 10/100 MAC 306, a packet buffer 307, a 16-bit CPU interface 311 and a third 10/100 MAC 308, all

in communication with the bus 316, so as to facilitate communication among one another.

5 The switch engine queuing manager 301 and the packet buffer 307 are configured to cooperate with one another so as to facilitate communication of network packets through the Internet Protocol switch controller 201 and to facilitate insertion of voice data packets onto the network without blocking of the
10 network packets. An integrated address resolution unit is coupled to provide medium access control addresses and VLAN tag resolution at line rate. The integrated address resolution unit is configured to support ingress timestamp which in turn allows the queuing manager 301 to support egress delay flush. The
15 integrated address resolution unit may configured to provide 256 medium access control addresses with a 16 bit tag.

The switch engine queuing manager 301 prioritizes packets going into the packet buffer 307. Thus, the switch engine queuing manager 301 defines a prioritization circuit. This
20 prioritization applies to both voice data generated at the network telephone 101 by a user and voice data coming into the network telephone 101 from the network (if not already prioritized). Voice data may be recognized as such by the port it is received on (i.e., the MII port 203) by an identification
25 header of the data packet which identifies the data contained within the packet as voce data or by associating either the source or destination of the packet as a voice device, e.g., a network telephone.

It should be appreciated that both non-voice data, such as
30 that generated by the personal computer 102 and communicated to the network, as well as that provided by the network to the personal computer 102, passes through the network telephone 102 because of its serial connection between the personal computer 102 and the network switch 103. Thus, all such data must be
35 processed by the Internet Protocol switch controller 201 of the

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network phone 101. It is important that voice data be given a higher priority than non-voice data, since such voice data is
5 time critical, i.e., should pass through the network without unnecessary delay.

The avoidance of such delay is necessary so as to provide the desired degree of quality of service. As those skilled in the art will appreciate, a minimum threshold of quality of
10 service is necessary in order to make use of the network telephone 101 worthwhile and desirable. The introduction of undesirable delays in voice packets transmitted over the network tends to cause a reduction in quality of service which may, if excessive, make use of the network telephone 101 undesirable.

15 The VLAN 802.1Q address look-up engine 302 utilizes the ARL/VLAN table 303 to facilitate desired routing of voice packets, as well as non-voice packets, across the network.

The LED interface 304 facilitates the use of LEDs 312 which may be utilized to provide any desired indication, such as
20 transmit (TX), receive (RX) and status (network OK).

The search engine queuing manager 301 stores packets in the packet buffer 307 prior to the packets being sent to their destination, whether that destination is the voice engine processor 202 or the network. The packet buffer generally has
25 a capacity greater than 200 Kbytes.

The 16-bit CPU interface 311 forms a portion of the microprocessor interface 204 which facilitates communication of control signals between the Internet Protocol switch controller 201 and the voice engine processor 202. The CPU interface 311
30 may be configured to facilitate the use of SNMP and BPDU frames. The CPU interface 311 may have counters coupled to provide RMON support.

The media independent interface 203 facilitates the communication of data, e.g., voice packets, between the Internet
35 Protocol switch controller 201 and the voice engine processor

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202. The media independent interface facilitates such communication via 10/100 MAC 308.

5 First media dependent interface 313 and second media dependent interface 314 facilitate communication with the personal computer 102 and the network switch 103, respectively. Media dependent interface 313 facilitates data communication via 10/100 Ethernet transceiver 309 and 10/100 MAC 305. Similarly,
10 media dependent interface 314 facilitates data communication via 10/100 Ethernet transceiver 310 and 10/100 MAC 306.

The Internet Protocol switch VLAN tag frame format is generally defined in IEEE 802.3ac and 802.1Q. A four byte field is utilized and the tag is inserted between the source address
15 (SA) and the original type-length field of the frame. The tag is split into two 16 bit fields. The first field is a VLAN tag protocol identified (TPID) and the second field is the tag control information (TCI), which contains the VLAN identifier (typically 12 bits), a 3-bit user priority field, and one CFI
20 (Canonical Format Indicator) bit, which is generally not used in Ethernet networks.

Referring now to FIG. 4, the voice engine processor 202 comprises a CPU bus 420, which preferably operates at approximately 80 MHZ and a peripheral bus 421, which preferably
25 operates at approximately 40 MHZ. An internal peripheral bridge 408 facilitates communication between the peripheral bus 421 and the CPU bus 420.

A CPU 401, preferably a RISC CPU having built-in cache such as a MIPS R3000, is in communication with the CPU bus 420 through
30 DSP coprocessor 402. By using the DSP coprocessor 402, which cooperates with the CPU 401 the need for a off-chip DSP is eliminated.

At least one serial port 404, at least one general purpose input/output 405, a keyboard interface 406, at least one clock
35 or timer 409, interrupt controller 410 and an LCD interface

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controller 407 are in communication with the peripheral bus 421. An on-chip PLL 440 may be used to provide a plurality of
5 different clock speeds, e.g., 25 MHz, 33 MHz and 50 MHz.

A security module 411, a DMA arbiter 412, more than 20 Kbytes of SRAM buffer 413, a 14-bit CODE, a time division multiplexor interface 415 and a media independent interface 416 are in communication with the CPU bus 420. Also, a memory
10 interface 403 which facilitates interface to 100 MHZ SDRAM 417, SSRAM 418 and flash ROM 419 is also in communication with the CPU bus 420.

The serial port 404 facilitates programming of the flash ROM 419, as well as debugging of the network telephone 101, particularly the operation of the voice engine processor 202
15 thereof.

The general purpose input/output(s) 405 allow the voice engine processor 202 to control external devices and/or to accept input from external devices, as desired.

20 The keyboard interface 406 facilitates electrical communication with keypad 209 and the LCD interface controller 407 facilitates communication with the LCD display 210.

The timer(s) 409 provide the clock signal(s) necessary for operation of the serial port(s) 404, GPIO(s) 405, keyboard
25 interface 406, LCD interface controller 407 and interrupt controller 410. The interrupt controller 410 provides interrupts for the serial port(s) 404, GPIO(s) 405, keyboard interface 406 and LCD interface controller 407.

The GPIO(s) 405 facilitate debugging, the use of external
30 hdevices such as LED indicators and other desired customer specific external logic.

The security module 411 applies encryption, preferably according to the defense encryption standard (DES) utilizing either single or triple DES and also facilitates decryption of
35 encrypted data.

The DMA (Direct Memory Access) arbiter 412 controls access to the CPU bus 420 so as to facilitate direct memory access operations.

The SRAM buffer 413 provides temporary storage for voice data as it is processed by the security module 411 and/or the CPU 401 and the DSP co-processor 402.

In the transmit direction, CODEC 414 performs analog-to-digital conversion and filters the digital samples. In the receive direction, the CODEC 414 filters the received digital samples taken from the co-processor and then performs digital-to-analog conversion.

The DSP co-processor 402 is used to compress the voice data.

The CODEC 414 may be a G.711 CODEC and facilitates compression of voice data provided by the microphone 211 and facilitates decompression of voice data provided to the speaker 212. The CODEC 414 optionally also facilitates desired filtering of the voice packets provided by microphone 214, particularly so as to decrease the bandwidth necessary for transmission thereof.

Analog input circuit 430 receives an analog voice signal from the microphone 211 and conditions the signal for input to the CODEC 414. The analog input circuit 430 optionally filters and/or amplifies the analog voice signal before the analog voice signal is provided to the CODEC 414.

The analog output circuit 431 receives an analog signal from the CODEC 414 and provides the analog signal to speaker 212. The analog output circuit 431 optionally amplifies and/or filters the analog signal prior to providing the analog signal to the speaker 212.

The analog input circuit 430 and the analog output circuit 431 may be formed separate and external with respect to the voice engine processor 202, if the voice engine processor 202 is formed as a single chip.

The TDM interface 415 facilitates the handling of time division multiplexed data packets communicated upon the CPU bus 420 according to contemporary methodology.

The media independent interface 416 facilitates the communication of voice data packets between the voice engine processor 202 and the Internet Protocol switch controller 201.

The 100 MHZ SDRAM 417 provides a storage place for packetized voice data. The SSRAM 418 provides program memory for network related operations executed by the CPU 401. The flash ROM 419 is used to store program instructions for the RISC CPU 401 which are likely to need periodic updating.

As those skilled in the art will appreciate, the 14-bit DSP co-processor 402 may perform various different types of voice compression. For example, the CODEC 414 may utilize pulse code modulation (PCM), differential pulse code modulation (DPCM), adaptive differential pulse code modulation (ADPCM), motion picture experts group (MPEG) audio compression, linear predictive coding (LPC), code-excited linear prediction (CELP) and low-delay code-excited linear prediction (LD-CELP).

Of course, silence suppression is included in any type of audio compression. Those skilled in the art will appreciate that various other types of voice compression may likewise be suitable. The voice engine processor 202 is configured to provide echo control.

The voice engine processor 202 may optionally be configured to provide signaling for voice traffic, such as PBX voice traffic.

Referring now to FIG. 5, the processing of an incoming voice data packet by the network telephone 101 is shown. As shown in block 501, an incoming voice data packet is received by the network telephone 101. This incoming voice data packet is typically received via the media dependent interface 314 which facilitates communication with the network. Thus, the incoming

voice data packet typically originates elsewhere upon the network, such as at another network telephone. However, such incoming voice data packets may alternatively originate at the personal computer 102 (such as by using the personal computer itself as a network telephone) or may originate at various network devices such as other computers (which are similarly utilized as network telephones) or servers which may have previously archived the voice data packet.

Regardless of the source of the incoming data packet. The address lookup engine will use the various DA and VLAN tag fields, as well as the ingress port identity (and possibly SA field), to determine which port(s) to queue the packet to, and whether to place it on the high or low priority queue(s) of the determined egress port(s). The priority tag of the voice data packet, if present, is read by the search engine queuing manager 301 of the IP switch controller 201 as shown in block 502. If the priority tag indicates that the packet contains voice data and therefore should be processed with high priority, the packet will be stored on the high priority queue. Processing with high priority includes placing voice data packets ahead of other, lower priority packets in buffers, such that voice data packets are read from the buffers before other, non-voice data packets. In this manner, undesirable delays of the voice data packets are mitigated.

Thus, as shown in block 503, the voice data packet is stored by switch engine queuing manager 301 in packet buffer 307 for read-out from packet buffer 307 ahead of non-voice data packets and after any previously stored voice data packets. In this manner, voice data packets are read ahead of non-voice data packets and the order of voice data packets is maintained.

Since it is possible for voice data packets to arrive at the network telephone 101 out of order, the switch engine queuing manager 301 also places arriving packets in the packet buffer 307

in order, to the extent possible. The order of voice data packets is indicated in a header thereof. If a later transmitted voice data packet arrives before an earlier transmitted voice data packet, then the earlier transmitted voice data packet is placed in the voice data packet buffer 307 ahead of the later transmitted voice data packet. In this manner, the switch engine queuing manager 301 attempts to maintain desired order of the voice data packets, such that undesirable disruptions of received speech are mitigated. Of course, if an earlier transmitted voice data packet arrives after a later transmitted voice data packet has already been read from packet buffer 307 (and has generally already been listened to via speaker 212), then the earlier transmitted voice data packet must be deleted, e.g., not stored in packet buffer 307, so as to mitigate further degradation of the incoming voice data stream.

If the address lookup 302 determines the packet is destined for internet telephone 101, it will queue the packet to the MII port 203, and directs the queuing manager 301 to place it on the high priority queue for that port, assuming its priority field indicated this. After the voice data packets have been queued ahead of non-voice data packets and stored in order, to the extent possible, the voice data packets are communicated from the packet buffer 307 to SRAM buffer 413 of the voice engine processor 202 via media independent interface 203, as show in block 504. Voice data packets may also be stored in the 100 MHZ SDRAM, as necessary to prevent over flowing of the SRAM buffer 413. The voice engine processor processes the voice data packets so as to provide a voice signal compatible with speaker 212 to facilitate listening to the received voice signal. Such processing is performed by the CPU 401 and the DSP coprocessor 402 by executing instructions stored in the SSRAM 418 and flash ROM 419 while operating upon voice data packets stored in SRAM buffer 413. Additionally, voice data packets are transferred

from the 100 MHZ SDRAM 417 to the SRAM buffer 413 as necessary to facilitate further processing thereof.

5 As shown in block 505, the CPU 401 of the voice engine processor 202 facilitates de-packetizing of the voice data packets stored in SRAM buffer 413.

As shown in block 506, if the voice data packets are encrypted, then the security module 401 decrypts the voice data
10 packets.

As shown in block 507, DSP co-processor 402 decompresses packetized voice data. If pulse code modulation (PCM) only is used, then such decompression inherently results in digital-to-analog conversion of the voice signal. However, if more
15 sophisticated voice compression is utilized, then CODEC 414 performs decompression of the voice signal and then performs digital-to-analog conversion thereof, as shown in block 508.

As shown in block 509, the decompressed analog signal is provided to analog output 431 which conditions, e.g., filters,
20 amplifies and/or attenuates, the signal such that the signal is suitable for speaker 212.

Referring now to FIG. 6, the processing of outgoing voice data from the network telephone 101 is generally the reverse of the processing of incoming voice data, as shown in FIG. 5.

25 More particularly, as shown in block 601 an analog voice signal which results from talking into microphone 211 is communicated from microphone 211 to voice engine processor 202 via analog input circuit 430. The analog input circuit 430 conditions the output of microphone 211 so as to be suitable for
30 processing by CODEC 414 of the voice engine processor 202. Thus, the analog input circuit 430 filters, amplifies and/or attenuates the analog voice signal communicated from the microphone.

As shown in block 602, CODEC 414 performs analog-to-digital conversion on the analog voice signal and stores the digital
35 voice signal in SRAM buffer 413. If only PCM voice compression

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is utilized, then the analog-to-digital conversion process results in a compressed digital voice signal.

5 As shown in block 603, if more sophisticated compression is utilized, then DSP co-processor 402 compresses the digitized voice signal, utilizing such voice compression.

As shown in block 604, security module 411 encrypts the compressed voice signal, if desired. Defense encryption standard
10 (DES) or triple DES are utilized. However, those skilled in the art will appreciate that various other types of encryption are likewise suitable and may either alternatively or additionally be utilized.

As shown in block 605, CPU 401 packetizes the voice signal,
15 such that the voice signal is suitable for transmission over a network, such as the Internet.

As shown in block 606, the voice data packet is communicated from the SRAM buffer 413 and/or 100 MHZ SDRAM to the packet
20 buffer 307 of the IP switch controller 201, via media independent interface 203.

The address lookup engine 302 uses the DA, VLAN tag and ingress port to determine the egress port(s) to which the frame must be queued, and informs the switch engine queuing manager 301 of this decision, as well as whether to queue as high or low
25 priority. In general, all packets originating from internet telephone 101 will be tagged as high priority.

As shown in block 607, a priority tag is applied to the voice data packet by the search engine queuing manager 301 of the IP switch controller 201. Routing information may also be
30 applied to the voice data packet by the queuing manager, in accordance with the instructions from the VLAN 802.1Q address lookup engine 302 and the ARL/VLAN table 303.

As shown in block 608, the voice data packet is stored by switch engine queuing manager 301 and packet buffer 307 for read-
35 out from packet buffer 307 ahead of non-voice data packets (which

may have arrived from either the network or personal computer 102) and after any previously stored voice data packets. In this manner, the priority necessary to maintain the desired quality of service and to prevent undesirable degradation of the voice signal is provided.

It is worthwhile to note that other data packets, besides those originating at the network telephone 101 may be stored in packet buffer 307 and then transmitted to the network. For example, data packets provided by personal computer 102 must be transmitted, without detrimental alteration, to switch 103 of the network. The switch engine queuing manager 301 may, optionally, apply a desired priority tag to such non-voice data packets which originated at the personal computer 102. These non-voice data packets will be assigned a priority lower than that of the voice data packets which originate at the network telephone 101.

As shown in block 609, voice data packets are transmitted from the network telephone to the network, via media dependent interface 314, which typically facilitates transmission of the voice data packets to switch network 103 or any other desired network device. The voice data packets are then routed by switch 103 using routing information, such as that applied by the VLAN address look-up table 302 to the voice data packets according to contemporary methodology.

Referring now to FIG. 7, the application of priority tags to data packets passing through the network telephone 101 is shown. The priority tags are applied by the switch engine queuing manager 301 prior to storing the data packets in packet buffer 307.

As shown in block 701, packets are received by the IP switch controller 201 of the network telephone 101. These packets may be received from the network, the personal computer 102 or the voice engine processor 202 (which occurs when the packets originate at the network telephone 101 and are the result of

speech from the microphone 211, or entries on the keypad 209, being processed by voice engine processor 202).

5 As shown in block 702, high priority packets are processed differently from low priority packets. High priority packets are voice data packets and low priority packets are non-voice data packets. If the packet received by the IP switch controller 201 is a non-voice data packet (as indicated by the packet header or
10 routing information), then processing is transferred to block 703, wherein the switch engine queuing manager 301 stores the packet for low priority use in the packet buffer 307. Storing the packet for low priority use may be accomplished by storing the packet in a dedicated low priority portion of the packet
15 buffer 307, may comprise maintaining a table of the storage location of the low priority packet such that the packet may later be recognized as a low priority packet or may include the application of a priority tag to the packet, such that the packet is readily recognized as a low priority packet.

20 As shown in block 704, when the packet is recognized as a high priority packet, i.e., a voice data packet, by block 702, then the switch engine queuing manager 301 stores the packet for high priority use in packet buffer 307. Similarly, the high priority packet may be stored in a dedicated high priority
25 portion of the packet buffer 307, a table may be maintained designating where high priority packets are stored within the packet buffer 307, or a tag may be applied to the packet such that the packet may be readily identified as a high priority packet.

30 As shown in block 705, packets are read from the packet buffer 307 in order, according to priority of the packets. That is, high priority packets are read from the packet buffer 307, generally in order of their reception, and then low priority packets are read from the packet buffer 307. Thus, higher
35 priority voice data packets are read from the packet buffer 307

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and are processed prior to reading lower priority non-voice data
packets from the packet buffer 307 and processing the lower
5 priority non-voice data packets.

Note that while FIG. 7 shows only two levels of priority,
high and low, the 3-bit user priority field in the 802.3ac/802.1Q
tag allows eight levels of priority to be encoded, and the IP
switch could be extended to support these multiple priority
10 queues.

It is understood that the exemplary network telephone system
described herein and shown in the drawings represents only a
presently preferred embodiment of the invention. Indeed, various
modifications and additions may be made to such embodiment
15 without departing from the spirit and scope of the invention.

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CLAIMS

1. A network telephone comprising:
a microphone coupled to provide voice data to a network;
a speaker configured to facilitate listening to voice data from the network;
a dialing device coupled to facilitate routing of voice data upon the network;
a first port configured to facilitate communication with a first network device;
a second port configured to facilitate communication with a second network device; and
a prioritization circuit coupled to apply prioritization to voice data provided by the microphone.

2. The network telephone as recited in claim 1, wherein the first port is configured to facilitate communication of voice data packets with the first network device and the second port is configured to facilitate communication of voice data packets with the second network device.

3. The network telephone as recited in claim 1, wherein the microphone and the speaker at least partially define a handset.

4. The network telephone as recited in claim 1, wherein the dialing device comprises a keypad.

5. The network telephone as recited in claim 1, wherein the first port and the second port comprise Ethernet 10/100 ports.

6. The network telephone as recited in claim 1, wherein the prioritization circuit is defined by a network switch.

7. The network telephone as recited in claim 1, wherein the prioritization circuit is defined by an Ethernet switch.

5

8. The network telephone as recited in claim 1, wherein: the prioritization circuit is defined by a network switch; and

10 further comprising a voice engine processor in communication with the network switch, the voice engine processor being configured to digitize and compress voice data from the microphone and to decompress and perform digital to analog conversion upon voice data provided to the speaker.

15 9. The network telephone as recited in claim 1, wherein: the prioritization circuit is defined by a network switch; and

20 further comprising a voice engine processor in communication with the network switch, the voice engine processor being configured to digitize, compress and packetize voice data from the microphone and to depacketize, decompress and perform digital to analog conversion upon voice data provided to the speaker.

25 10. The network telephone as recited in claim 1, wherein the prioritization circuit is configured to tag voice data packets to facilitate prioritization thereof.

30 11. The network telephone as recited in claim 1, wherein the prioritization circuit is configured to tag voice data packets to facilitate prioritization thereof and is configured to read tags on data packets provided thereto by the network to facilitate prioritization thereof.

35

12. A network telephone comprising:

5 a switch controller having at least one port for facilitating electrical communication with a network; and
a voice engine processor in electrical communication with the switch controller, the voice processor having a microphone port for facilitating electrical communication with a microphone and having a speaker port for facilitating electrical
10 communication with a speaker.

13. The telephone as recited in claim 12, wherein the switch controller is configured to apply prioritization to voice packets.

14. The telephone as recited in claim 12, wherein the switch controller is configured to apply prioritization to voice data packets and to route voice data packets over a network.

15. The telephone as recited in claim 12, wherein the switch controller is configured to apply prioritization to voice data packets and to route voice data packets over an Ethernet.

16. The telephone as recited in claim 12, wherein the switch controller is configured to apply prioritization to voice data packets and to route voice data packets over the Internet.

17. The telephone as recited in claim 12, wherein the switch controller is configured to apply prioritization to voice data packets provided by the microphone and coupled to route the voice data packets over a network.

18. The network telephone as recited in claim 12, wherein the switch controller is configured to tag voice data packets to facilitate prioritization thereof.

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19. The network telephone as recited in claim 12, wherein
the switch controller is configured to tag voice data packets to
5 facilitate prioritization thereof and is configured to read tags
on data packets provided thereto by the network to facilitate
prioritization thereof.

20. The telephone as recited in claim 12, wherein the
10 switch controller is configured to be compatible with Internet
Protocol.

21. The telephone as recited in claim 12, wherein
electrical communication between the switch controller and the
15 voice engine processor is facilitated via a media independent
interface and a microprocessor interface.

22. The telephone as recited in claim 12, wherein the
switch controller comprises two ports for facilitating
20 communication with the network.

23. The telephone as recited in claim 12, wherein the
switch controller comprises two Ethernet ports for facilitating
communication with the network.

24. The telephone as recited in claim 12, wherein the
switch controller comprises two 10/100 megabit/sec Ethernet ports
for facilitating communication with the network.

25. The telephone as recited in claim 12, wherein the voice
engine processor further comprises a keypad port for facilitating
communication with a keypad.

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26. The telephone as recited in claim 12, wherein the voice
engine processor further comprises a display port for
5 facilitating communication with a display.

27. The telephone as recited in claim 12, wherein the
switch controller is configure to be placed serially into a
Ethernet transmission medium intermediate a network interface
10 card and a switch.

28. The telephone as recited in claim 12, wherein the voice
engine processor is configured to compress voice communications.

29. The telephone as recited in claim 12, wherein the voice
engine processor is configured to compress voice communications
using PCM compression.

30. The telephone as recited in claim 12, wherein the voice
engine processor is configured to suppress silence.

31. The telephone as recited in claim 12, wherein the voice
engine processor is configured to provide a desired level of
quality of service.

32. The telephone as recited in claim 12, wherein the voice
engine processor is configured to provide signaling for voice
traffic.

33. The telephone as recited in claim 12, wherein the voice
engine processor is configured to provide signaling for PBX voice
traffic.

34. The telephone as recited in claim 12, wherein the voice
engine processor is configured to provide echo control.

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35. A network telephone comprising a prioritization circuit coupled to tag voice data packets with information representative of a priority thereof and coupled to read tags associated with packets.

36. A switch controller for controlling a network switch through which voice data is communicated, the switch controller comprising:

a packet buffer coupled to buffer voice data packets and non-voice data packets;

a switch engine queuing manager coupled to queue voice data packets and non-voice data packets in the packet buffer in a manner which enhances quality of service for the voice data packets;

at least one transceiver in communication with the packet buffer;

a network interface coupled facilitate communication between each transceiver and a network; and

a voice interface coupled to facilitate communication between a voice source and the packet buffer.

37. The switch controller as recited in claim 36, wherein the transceiver comprises a 10/100 transceiver.

38. The switch controller as recited in claim 36, further comprising a medium access control for each transceiver coupled to facilitate communication of voice packets and non-voice packets between the packet buffer and a network.

39. The switch controller as recited in claim 36, further comprising a 10/100 medium access control for each transceiver.

35

40. The switch controller as recited in claim 36, further comprising a medium access control coupled to facilitate
5 communication of voice data packets between the voice source and the packet buffer via the voice interface.

41. The switch controller as recited in claim 36, further comprising a media dependent interface coupled to facilitate
10 communication between each transceiver and the network.

42. The switch controller as recited in claim 36, further comprising a media independent interface coupled to facilitate
15 communication between the packet buffer and the voice source.

43. The switch controller as recited in claim 36, further comprising a CPU interface coupled to facilitate communication
between a CPU and the search engine queuing manager.

44. The switch controller as recited in claim 36, further comprising a CPU interface coupled to facilitate communication
20 between a CPU and the search engine queuing manager, the CPU interface facilitating use of SNMP and BPDU frames.

45. The switch controller as recited in claim 36, further comprising a CPU interface coupled to facilitate communication
25 between a CPU and the search engine queuing manager, the CPU interface having counters coupled to provide RMON support.

46. The switch controller as recited in claim 36, further comprising:
30 an address table; and

an address lookup engine couple to fetch addresses from the address table and to provide the addresses to the transceiver(s)
35 to facilitate network routing.

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47. The switch controller as recited in claim 36, further comprising:

5 a VLAN address table; and
an VLAN address lookup engine couple to fetch addresses from the address table and to provide the addresses to the transceiver(s) to facilitate network routing.

10 48. The switch controller as recited in claim 36, further comprising:

a display coupled to indicated a status of the switch controller; and

15 a display interface coupled to communicate status information to the display.

49. The switch controller as recited in claim 36, further comprising:

20 a plurality of LEDs coupled to indicated a status of the switch controller; and

an LED interface coupled to communicate status information to the LEDs.

50. The switch controller as recited in claim 36, wherein
25 the switch engine queuing manager and the packet buffer are configured to cooperate so as to facilitate communication of network packets through the switch controller and to facilitate insertion of voice packets onto the network without blocking of the network packets.

30 51. The switch controller as recited in claim 36, further comprising an integrated address resolution unit coupled to provide medium access control addresses and VLAN tag resolution.

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52. The switch controller as recited in claim 36, further comprising an integrated address resolution unit coupled to provide medium access control addresses and VLAN tag resolution at line rate.

53. The switch controller as recited in claim 36, further comprising an integrated address resolution unit configured to support ingress timestamp and egress delay flush.

54. The switch controller as recited in claim 36, further comprising an integrated address resolution unit configured to provide 256 medium access control addresses with a 16 bit tag.

55. A voice engine processor for use in network telephony, the voice engine processor comprising:

- a CODEC;
- a input port coupled to communicate an input audio signal from an input transducer to the CODEC;
- an output port coupled to communicate an output audio signal from the CODEC to an output transducer;
- a CPU; and
- a DSP coprocessor coupled to the CPU so as to facilitate digital signal processing of voice data.

56. The voice engine as recited in claim 55, further comprising a microprocessor interface coupled to facilitate communication between the CPU and a switch controller.

57. The voice engine as recited in claim 55, wherein the CODEC comprises a 14 bit CODEC.

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58. The voice engine as recited in claim 55, wherein the
input port is configured to communicate a microphone output
5 signal to the CODEC.

59. The voice engine as recited in claim 55, wherein the
output port is configured to communicate an audio signal to a
speaker.

10

60. The voice engine as recited in claim 55, further
comprising:

a CPU;

memory in communication with the CPU;

15

a buffer; and

wherein the CPU is responsive to instructions stored in the
memory so as to effect storage of information representative of
at least one of the input audio signal and the output audio
signal in the buffer.

20

61. The voice engine as recited in claim 55, further
comprising:

a CPU;

memory in communication with the CPU;

25

a buffer in communication with the CPU; and

a digital signal coprocessor in communication with the CPU.

62. The voice engine as recited in claim 55, further
comprising:

30

a serial port in communication with the CPU;

a general purpose input/output port in communication with
the CPU;

a keyboard port in communication with the CPU; and

an LCD controller in communication with the CPU.

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63. The voice engine as recited in claim 55, further comprising:

- 5 a serial port in communication with the CPU;
a general purpose input/output port in communication with the CPU;
a keyboard port in communication with the CPU;
an LCD controller in communication with the CPU;
10 a clock in communication with the CPU; and
an interrupt controller in communication with the CPU.

64. The voice engine as recited in claim 55, further comprising:

- 15 a peripheral bus in communication with the CPU via an IPB bridge;
a serial port in communication with the peripheral bus;
a general purpose input/output port in communication with the peripheral bus;
20 a keyboard port in communication with the peripheral bus;
an LCD controller in communication with the peripheral bus;
a clock in communication with the peripheral bus; and
an interrupt controller in communication with the peripheral bus.

25 65. The voice engine as recited in claim 55, further comprising:

- a security module in communication with the CPU;
a DMA buffer in communication with the CPU;
30 a TDM interface in communication with the CPU; and
a MII interface in communication with the CPU.

35

66. The voice engine as recited in claim 55, further comprising:

- 5 a CPU bus in communication with the CPU;
a security module in communication with the CPU bus;
a DMA buffer in communication with the CPU bus;
a TDM interface in communication with the CPU bus; and
a MII interface in communication with the CPU bus.

10

67. The voice engine as recited in claim 55, further comprising:

- a memory interface in communication with the CPU;
SDRAM in communication with the memory interface;
15 SSRAM in communication with the memory interface; and
flash ROM in communication with the memory interface.

15

~~68.~~ A network telephone system comprising:

- a network; and
20 at least one network telephone, each network telephone
comprising a network switch coupled to apply prioritization to
voice packets and coupled to read prioritization of voice
packets.

20

~~69.~~ A method for communicating voice via a network, the method comprising:

25

facilitating routing of voice data upon the network via a
dialing device;

providing voice data to a network via a microphone;

30

listening to voice data from the network via a speaker;

facilitating communication with a first network device via
a first port;

facilitating communication with a second network device via
a second port; and

35

prioritizing voice data provided by the microphone.

70. The method as recited in claim 69, wherein the first
port is configured to facilitate communication of voice packets
5 with the first network device and the second port is configured
to facilitate communication of voice packets with the second
network device.

71. The method as recited in claim 69, wherein the
10 microphone and the speaker comprise a handset.

72. The method as recited in claim 69, wherein the dialing
device comprises a keypad.

73. The method as recited in claim 69, wherein the first
15 port and the second port comprise Ethernet 10/100 ports.

74. The method as recited in claim 69, wherein the
prioritization circuit is defined by a network switch.
20

75. The method as recited in claim 69, wherein the
prioritization circuit is defined by an Ethernet switch.

76. The method as recited in claim 69, wherein:
25 the prioritization circuit is defined by a network switch;
and

further comprising a voice engine processor in communication
with the network switch, the voice engine processor being
configured to digitize and compress voice data from the
30 microphone and to decompress and perform digital to analog
conversion upon voice data provided to the speaker.

77. The method as recited in claim 69, wherein:
the prioritization circuit is defined by a network switch;
35 and

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5 further comprising a voice engine processor in communication with the network switch, the voice engine processor being configured to digitize, compress voice and packetize data from the microphone and to depacketize, decompress and perform digital to analog conversion upon voice data provided to the speaker.

10 78. The method as recited in claim 69, wherein the prioritization circuit is configured to tag voice packet to facilitate prioritization thereof.

15 79. The method as recited in claim 69, wherein the prioritization circuit is configured to tag voice packet to facilitate prioritization thereof and is configured to read tags on data packets provided thereto by the network to facilitate prioritization thereof.

20 ~~80.~~ A method comprising:
using a switch controller having at least one port to facilitate electrical communication with a network; and
using a voice engine processor in electrical communication with the switch controller to process voice, the voice processor having a microphone port for facilitating electrical
25 communication with a microphone and having a speaker port for facilitating electrical communication with a speaker.

30 81. The method as recited in claim 80, wherein the switch controller is configured to apply prioritization to voice packets.

35 82. The method as recited in claim 80, wherein the switch controller is configured to apply prioritization to voice packets and to route voice packets over a network.

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83. The method as recited in claim 80, wherein the switch
controller is configured to apply prioritization to voice packets
5 and to route voice packets over an Ethernet.

84. The method as recited in claim 80, wherein the switch
controller is configured to apply prioritization to voice packets
and to route voice packets over the Internet.

10

85. The method as recited in claim 80, wherein the switch
controller is configured to apply prioritization to voice packets
provided by the microphone and coupled to route the vice packets
over a network.

15

86. The method as recited in claim 80, wherein the switch
controller is configured to tag voice packet to facilitate
prioritization thereof.

20

87. The method as recited in claim 80, wherein the switch
controller is configured to tag voice packet to facilitate
prioritization thereof and is configured to read tags on data
packets provided thereto by the network to facilitate
prioritization thereof.

25

88. The method as recited in claim 80, wherein the switch
controller is configured to be compatible with Internet Protocol.

89. The method as recited in claim 80, wherein electrical
communication between the switch controller and the voice engine
processor is facilitated via a media independent interface and
a microprocessor interface.

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90. The method as recited in claim 80, wherein the switch controller comprises two ports for facilitating communication with the network.
5

91. The method as recited in claim 80, wherein the switch controller comprises two Ethernet ports for facilitating communication with the network.
10

92. The method as recited in claim 80, wherein the switch controller comprises two 10/100 megabit/sec Ethernet ports for facilitating communication with the network.
15

93. The method as recited in claim 80, wherein the voice engine processor further comprises a keypad port for facilitating communication with a keypad.
20

94. The method as recited in claim 80, wherein the voice engine processor further comprises a display port for facilitating communication with a display.
25

95. The method as recited in claim 80, wherein the switch controller is configure to be place serially into a Ethernet transmission medium intermediate a network interface card and a switch.
30

96. The method as recited in claim 80, wherein the voice engine processor is configured to compress voice communications.
35

97. The method as recited in claim 80, wherein the voice engine processor is configured to compress voice communications using PCM compression.
40

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98. The method as recited in claim 80, wherein the voice engine processor is configured to suppress silence.

5

99. The method as recited in claim 80, wherein the voice engine processor is configured to provide a desired level of quality of service.

10

100. The method as recited in claim 80, wherein the voice engine processor is configured to provide signaling for voice traffic.

15

101. The method as recited in claim 80, wherein the voice engine processor is configured to provide signaling for PBX voice traffic.

20

102. The method as recited in claim 80, wherein the voice engine processor is configured to provide echo control.

25

103. A method for communicating voice via a network, the method comprising tagging voice packets with information representative of a priority thereof and reading tags associated with packets.

30

104. A method for controlling a network switch through which voice data is communicated, the method comprising:

buffering voice packets and non-voice packets;

queuing voice packets and non-voice packets in the packet buffer in a manner which enhances quality of service for the voice packets;

communicating voice packets from the packet buffer to at least one transceiver;

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communicating voice packets between each transceiver and a network; and

5 communicating between a voice source and the packet buffer.

105. The method as recited in claim 104, wherein the transceiver comprises a 10/100 transceiver.

10 106. The method as recited in claim 104, further comprising a medium access control for each transceiver coupled to facilitate communication of voice packets and non-voice packets between the packet buffer and a network.

15 107. The method as recited in claim 104, further comprising a 10/100 medium access control for each transceiver.

20 108. The method as recited in claim 104, further comprising a medium access control coupled to facilitate communication of voice packets between the voice source and the packet buffer via the voice interface.

25 109. The method as recited in claim 104, further comprising a media dependent interface coupled to facilitate communication between each transceiver and the network.

30 110. The method as recited in claim 104, further comprising a media independent interface coupled to facilitate communication between the packet buffer and the voice source.

35 111. The method as recited in claim 104, further comprising a CPU interface coupled to facilitate communication between a CPU and the search engine queuing manager.

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112. The method as recited in claim 104, further comprising
a CPU interface coupled to facilitate communication between a CPU
5 and the search engine queuing manager, the CPU interface
facilitating use of SNMP and BPDU frames.

113. The method as recited in claim 104, further comprising
a CPU interface coupled to facilitate communication between a CPU
10 and the search engine queuing manager, the CPU interface having
counters coupled to provide RMON support.

114. The method as recited in claim 104, further comprising:
an address table; and
15 an address lookup engine couple to fetch addresses from the
address table and to provide the addresses to the transceiver(s)
to facilitate network routing.

115. The method as recited in claim 104, further comprising:
20 a VLAN address table; and
an VLAN address lookup engine couple to fetch addresses from
the address table and to provide the addresses to the
transceiver(s) to facilitate network routing.

116. The method as recited in claim 104, further comprising:
25 a display coupled to indicated a status of the switch
controller; and
a display interface coupled to facilitate communicate status
information to the display.

117. The method as recited in claim 104, further comprising:
30 a plurality of LEDs coupled to indicated a status of the
switch controller; and
an LED interface coupled to facilitate communicate status
35 information to the LEDs.

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118. The method as recited in claim 104, wherein the switch engine queuing manager and the packet buffer are configured to cooperate so as to facilitate communication of network packets through the switch controller and to facilitate insertion of voice packets onto the network without blocking of the network packets.

119. The method as recited in claim 104, further comprising an integrated address resolution unit coupled to provide medium access control addresses and VLAN tag resolution.

120. The method as recited in claim 104, further comprising an integrated address resolution unit coupled to provide medium access control addresses and VLAN tag resolution at line rate.

121. The method as recited in claim 104, further comprising an integrated address resolution unit configured to support ingress timestamp and egress delay flush.

122. The method as recited in claim 104, further comprising an integrated address resolution unit configured to provide 256 medium access control addresses with a 16 bit tag.

123. A method for processing voice for communication via a network, the method comprising:

communicating an analog input audio signal from an input transducer to an analog to digital converter to provide a digital input audio signal;

communicating a digital output audio signal to a digital to analog converter to provide an analog output audio signal to an output transducer; and

processing the digital input audio signal and the digital output audio signal with a DSP coprocessor coupled to the CPU.

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124. The method as recited in claim 123, further comprising
a microprocessor interface coupled to facilitate communication
5 between the CPU and a switch controller.

125. The method as recited in claim 123, wherein the CODEC
comprises a 14 bit CODEC.

10 126. The method as recited in claim 123, wherein the input
port is configured to communicate a microphone output signal to
the CODEC.

127. The method as recited in claim 123, wherein the output
15 port is configured to communicate an audio signal to a speaker.

128. The method as recited in claim 123, further comprising:
a CPU;
memory in communication with the CPU;
20 a buffer; and
wherein the CPU is responsive to instructions stored in the
memory so as to effect storage of information representative of
at least one of the input audio signal and the output audio
signal in the buffer.

25 129. The method as recited in claim 123, further comprising:
a CPU;
memory in communication with the CPU;
a buffer in communication with the CPU; and
30 a digital signal coprocessor in communication with the CPU.

130. The method as recited in claim 123, further comprising:
a serial port in communication with the CPU;
a general purpose input/output port in communication with
35 the CPU;

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a keyboard port in communication with the CPU; and
an LCD controller in communication with the CPU.

5

131. The method as recited in claim 123, further comprising:
a serial port in communication with the CPU;
a general purpose input/output port in communication with
the CPU;

10

a keyboard port in communication with the CPU;
an LCD controller in communication with the CPU;
a clock in communication with the CPU; and
an interrupt controller in communication with the CPU.

15

132. The method as recited in claim 123, further comprising:
a peripheral bus in communication with the CPU via an IPB
bridge:

20

a serial port in communication with the peripheral bus;
a general purpose input/output port in communication with
the peripheral bus;
a keyboard port in communication with the peripheral bus;
an LCD controller in communication with the peripheral bus;
a clock in communication with the peripheral bus; and
an interrupt controller in communication with the peripheral

25

bus.

30

133. The method as recited in claim 123, further comprising:
a security module in communication with the CPU;
a DMA buffer in communication with the CPU;
a TDM interface in communication with the CPU; and
a MII interface in communication with the CPU.

35

134. The method as recited in claim 123, further comprising:
a CPU bus in communication with the CPU;
a security module in communication with the CPU bus;

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a DMA buffer in communication with the CPU bus;
a TDM interface in communication with the CPU bus; and
5 a MII interface in communication with the CPU bus.

135. The method as recited in claim 123, further comprising:
a memory interface in communication with the CPU;
SDRAM in communication with the memory interface;
10 SSRAM in communication with the memory interface; and
flash ROM in communication with the memory interface.

136. A method for communicating voice comprising:
~~providing a network; and~~
15 applying prioritization to voice packets and reading
prioritization of voice packets via at least one network
telephone, each network telephone comprising a network switch.

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NETWORK TELEPHONY SYSTEM

5 ABSTRACT OF THE DISCLOSURE

10 The present invention includes a network telephone having
a microphone coupled to provide voice data to a network, a
speaker coupled to facilitate listening to voice data from the
network, a dialing device coupled to facilitate routing of voice
data upon the network, a first port configured to facilitate
communication with a first network device, a second port
configured to facilitate communication with a second network
device and a prioritization circuit coupled to apply
prioritization to voice data provided by the microphone.

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FIG. 1

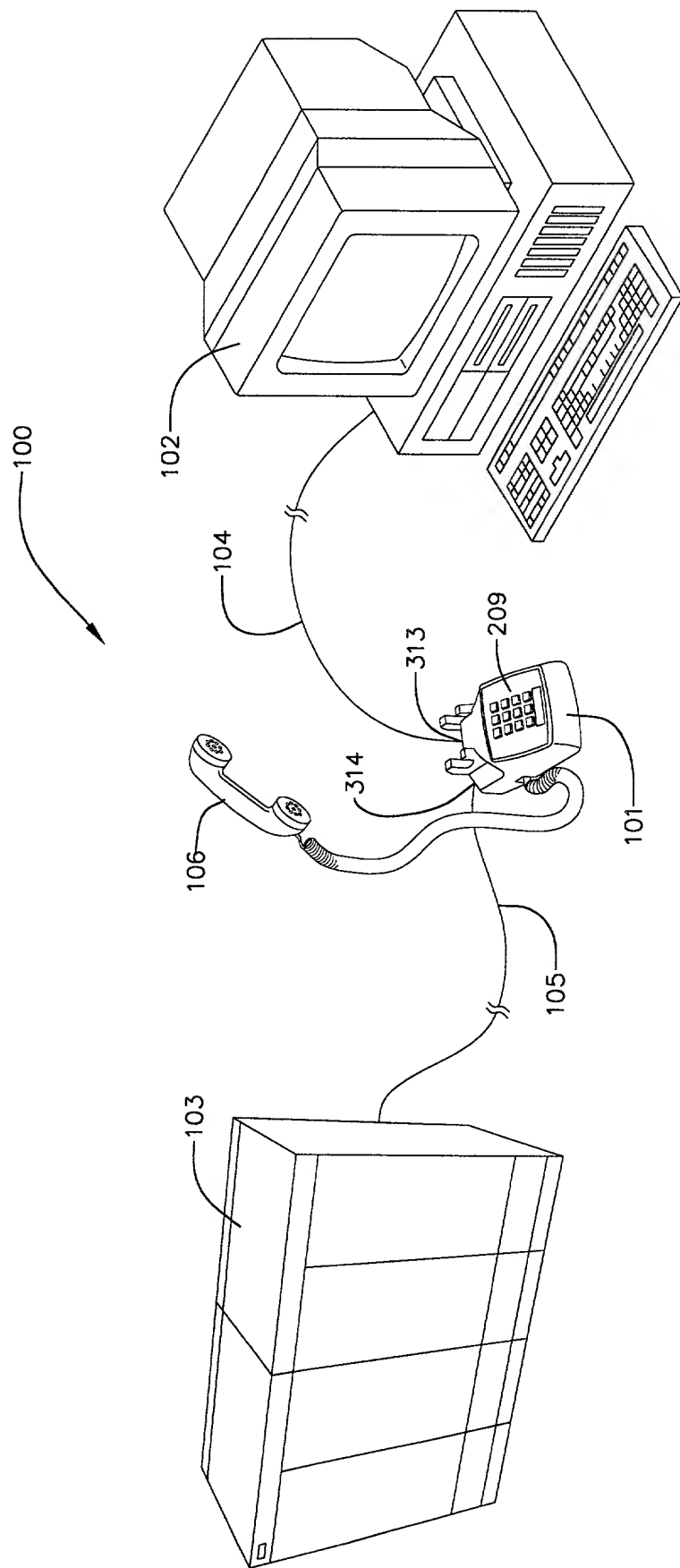


FIG. 2

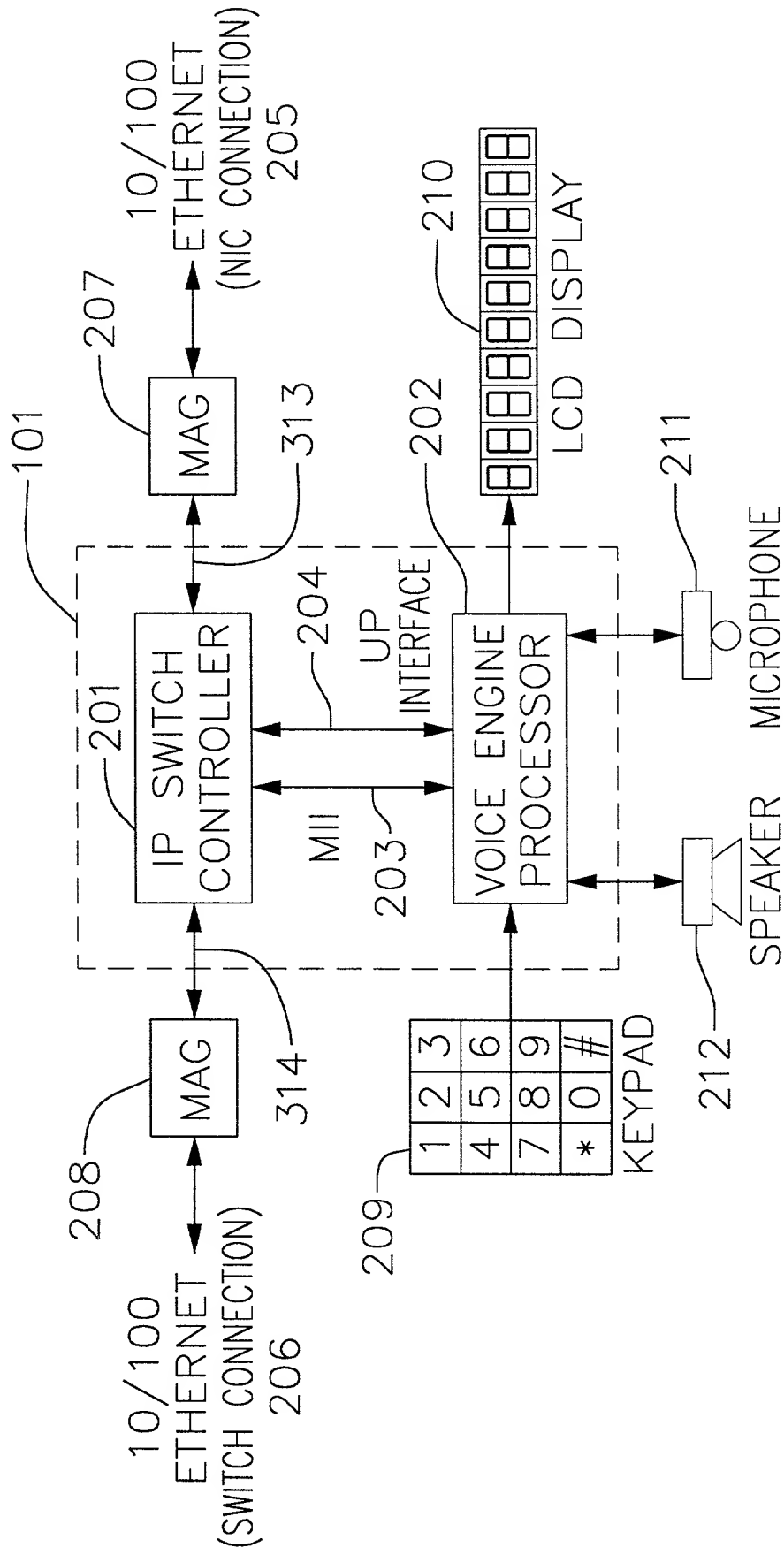
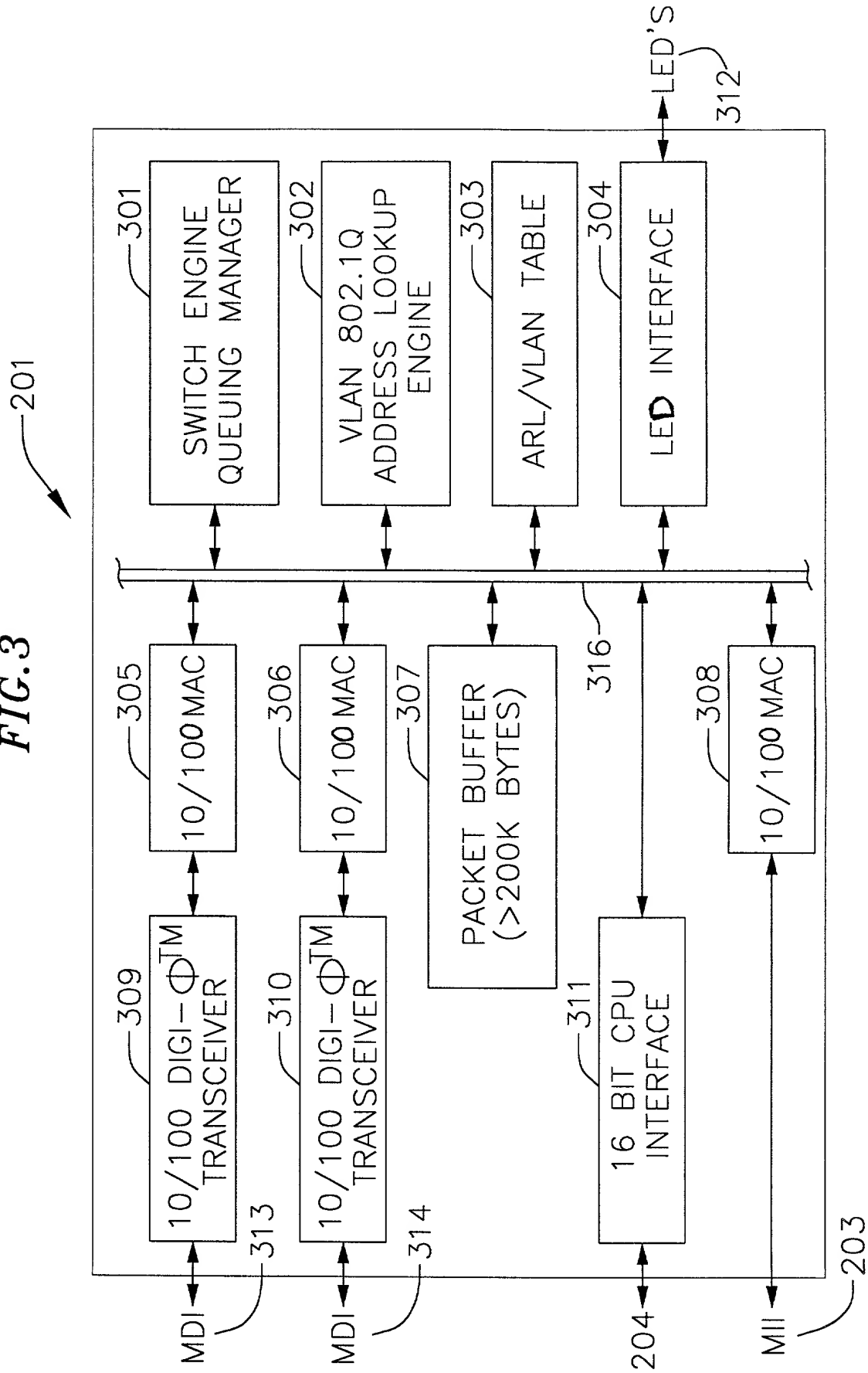


FIG. 3



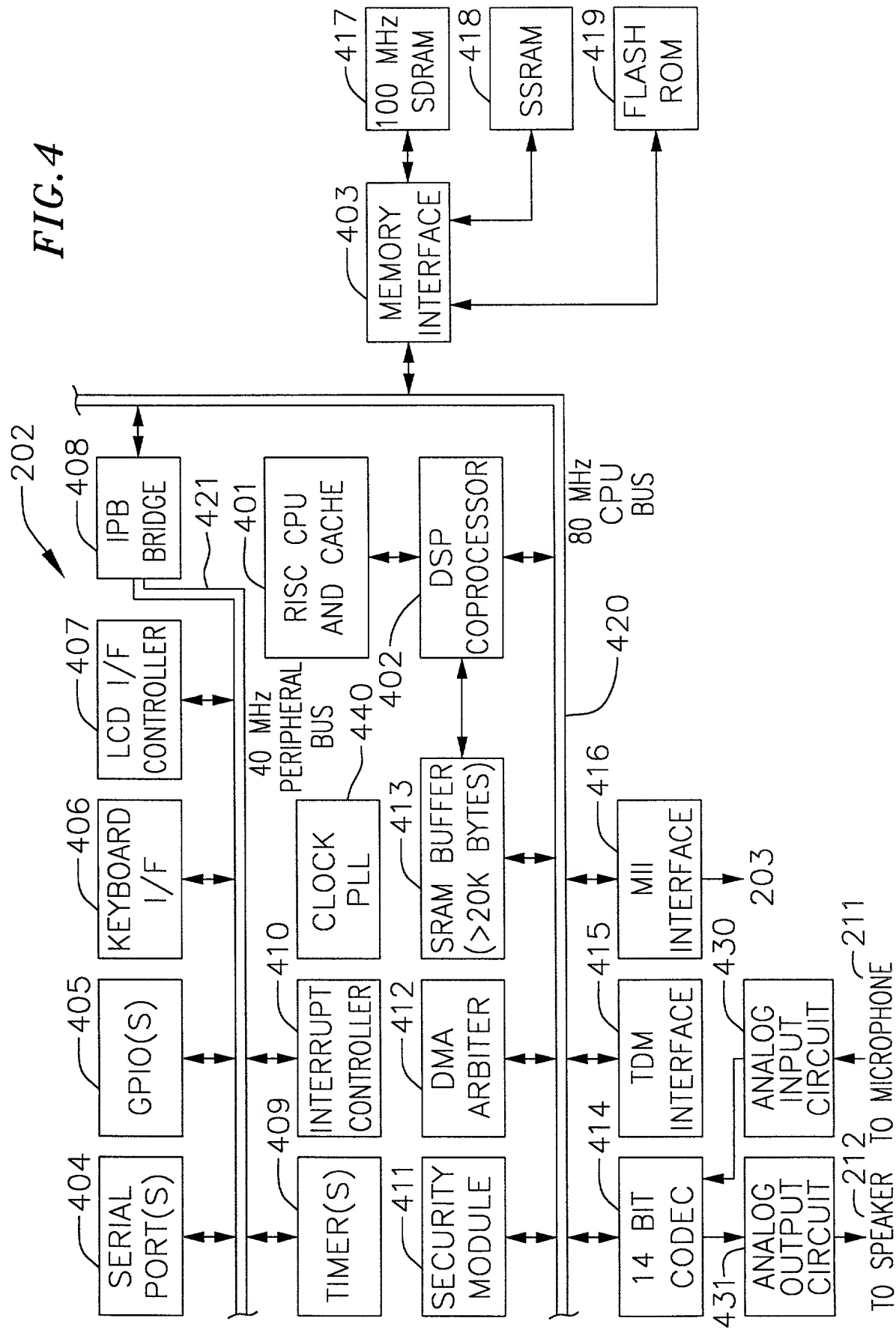


FIG. 6

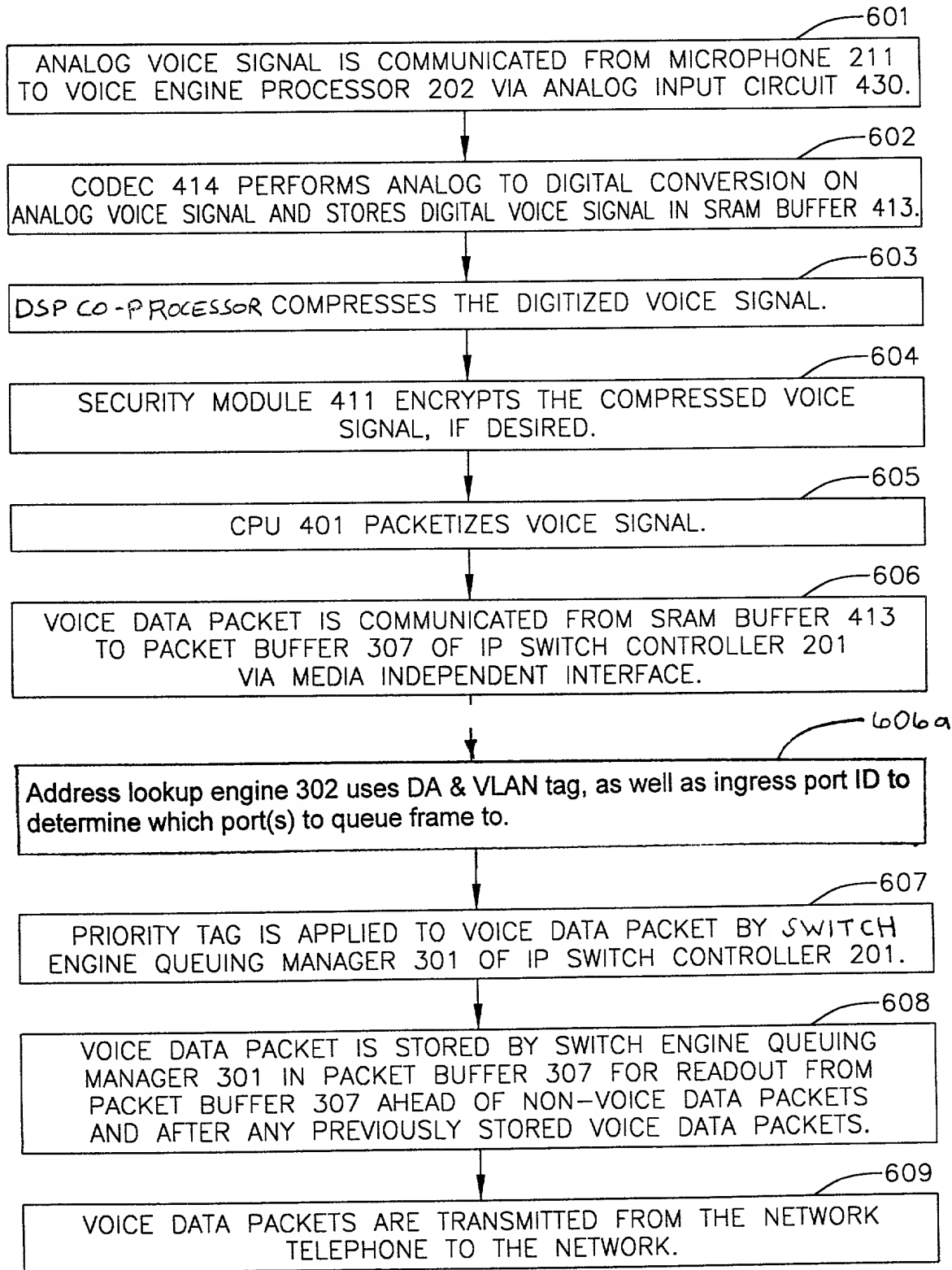
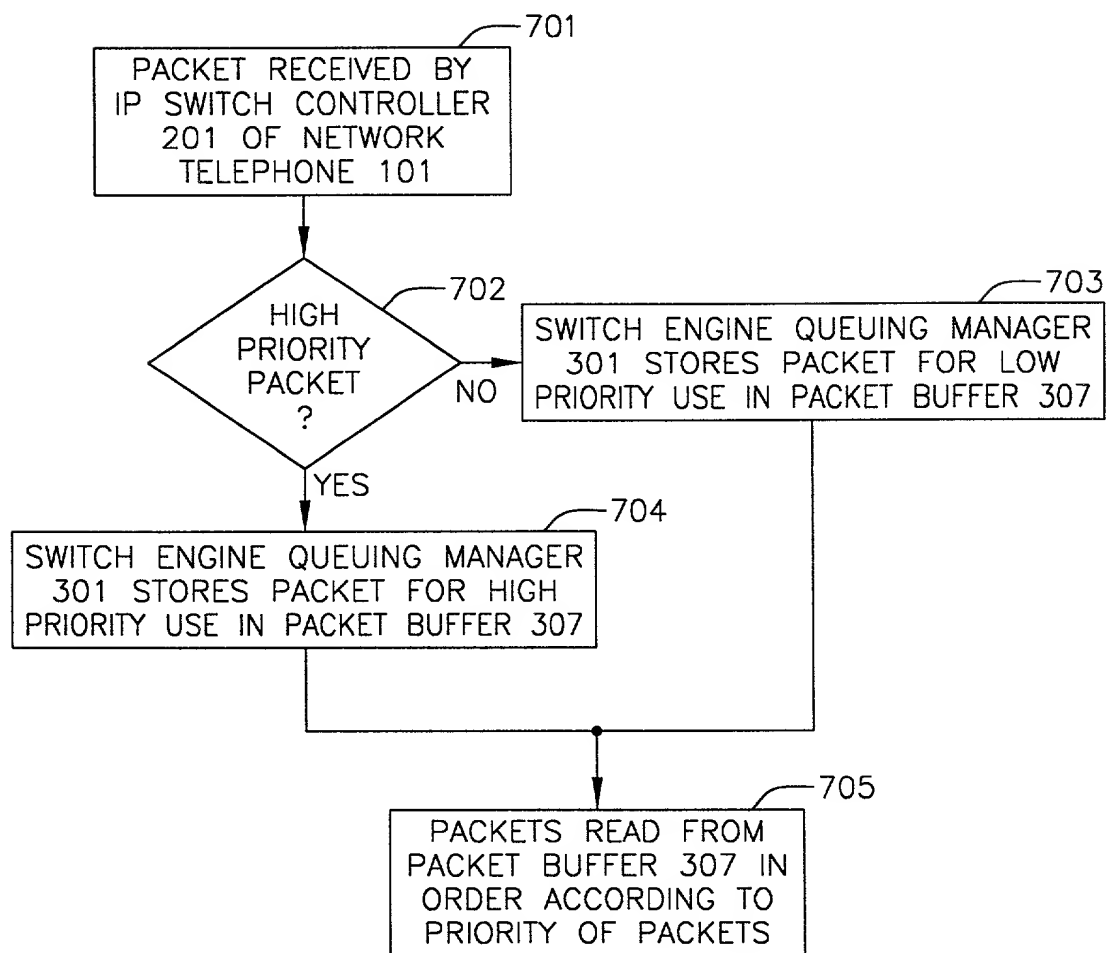


FIG. 7



**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATIONS**

PATENT

Docket No. : 36158/NEC/B600

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled NETWORK TELEPHONY SYSTEM, the specification of which is attached hereto unless the following is checked:

___ was filed on ___ as United States Application Number or PCT International Application Number ___ and was amended on ___ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of the foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

<u>Application Number</u>	<u>Country</u>	<u>Filing Date (day/month/year)</u>	<u>Priority Claimed</u>
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I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

<u>Application Number</u>	<u>Filing Date</u>
---------------------------	--------------------

60/110,211	11/30/98
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I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

<u>Application Number</u>	<u>Filing Date</u>	<u>Patented/Pending/Abandoned</u>
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POWER OF ATTORNEY: I hereby appoint the following attorneys and agents of the law firm CHRISTIE, PARKER & HALE, LLP to prosecute this application and any international application under the Patent Cooperation Treaty based on it and to transact all business in the U.S. Patent and Trademark Office connected with either of them in accordance with instructions from the assignee of the entire interest in this application;

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATIONS**

Docket No. 36158/NEC/B600

or from the first or sole inventor named below in the event the application is not assigned; or from __ in the event the power granted herein is for an application filed on behalf of a foreign attorney or agent.

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Edward R. Schwartz	(31,135)	Molly A. Holman	(40,022)	John F. O'Rourke	(38,985)

The authority under this Power of Attorney of each person named above shall automatically terminate and be revoked upon such person ceasing to be a member or associate of or of counsel to that law firm.

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**SEND CORRESPONDENCE TO : CHRISTIE, PARKER & HALE, LLP
P.O. Box 7068, Pasadena, CA 91109-7068**

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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